

What is claimed is:

1. A multiple frequency band antenna comprising:

a dipole antenna arranged on a straight line; and

5 at least two extension elements extending outward of respective ones of opposing outer ends of said dipole antenna along said straight line; wherein:

the length of said dipole antenna is determined to enable the multiple frequency band antenna to receive radio waves in a first frequency  
10 band, and the sum of the lengths of said dipole antenna and said two extension elements is determined to enable the multiple frequency band antenna to receive radio waves in a second frequency band lower than said first frequency band;

said multiple frequency band antenna further comprises:

15 first and second switch devices connected between respective ones of said two extension elements and associated ones of said outer ends of said dipole antennas; and

control means operating, when a radio wave in said first frequency band is to be received, to selectively place said first and second switch  
20 devices in a first state in which said first and second switch devices are opened, a second state in which said first switch device is closed and said second switch device is opened, and a third state in which said first switch is opened and said second switch device is closed.

25 2. The multiple frequency band antenna according to Claim 1 further comprising reactance elements connected in parallel with respective ones of said first and second switch devices, the values of said reactance elements being determined such as to substantially disconnect said dipole antenna and said extension elements in said first frequency band, and to substantially  
30 couple said dipole antenna and said extension elements in said second

frequency band; said control means operating to open said first and second switch devices when said multiple frequency band antenna is to receive a radio wave in said second frequency band.

5     3.             The multiple frequency band antenna according to Claim 1 wherein said dipole antenna comprises two, straight dipole antenna elements each comprising two spaced apart, parallel conductors coupled together in terms of high frequency; and each of said first and second switch devices comprises a PIN diode connected between the outer end of one of said two conductors and  
10   the extension element disposed outward of said outer end, and a DC current path connected between the other of said two conductors and said extension element.

4.             A multiple frequency band antenna comprising:  
15             first and second dipole antennas disposed in parallel with each other, being spaced from each other by a distance equal to or smaller than a quarter of a wavelength in a first frequency band;

              a group of extension elements including at least two first extension elements extending outward of respective ones of opposed outer  
20   ends of said first dipole antenna element along a first straight line, and at least two second extension elements extending outward of respective ones of opposed outer ends of said second dipole antenna element along a second straight line, the sum of the lengths of said first dipole antenna and said first extension elements and the sum of the lengths of said second dipole antenna  
25   and said second extension elements being so determined as to enable said multiple frequency band antenna to receive radio waves in a second frequency band lower than said first frequency band;

              a group of switch devices including first and second switch devices connected between the respective ones of said first extension  
30   elements and the respective ones of said outer ends of said first dipole

antenna, and third and fourth switch devices connected between the respective ones of said second extension elements and the respective ones of said outer ends of said second dipole antenna, said third and fourth switch devices being disposed at locations corresponding to the respective locations  
5 where said first and second switch devices are disposed;

control means operating, when said multiple frequency band antenna is to receive a radio wave in said first frequency band, to place said first, second, third and fourth switch devices selectively in a first state in which said first, second, third and fourth switch devices are opened, a second  
10 state in which said first and third switch devices are closed and said second and fourth switch devices are opened, and a third state in which said first and third switch devices are opened and said second and fourth switch devices are closed;

combining means connected to said first and second dipole  
15 antennas; and

phase shift means connected between said first and second dipole antennas and said combining means, said phase shift means being switchable between:

a first signal coupling state in which signals resulting  
20 from a radio wave coming to said multiple frequency band antenna from a first direction substantially perpendicular to said first and second dipole antennas, as received by said first and second dipole antenna elements, are coupled to said combining means substantially in phase with each other, and signals resulting from a  
25 radio wave coming to said multiple frequency band antenna from a second direction opposite to said first direction, as received by said first and second dipole antenna elements, are coupled to said combining means substantially in 180° out of phase with each other, and

30 a second signal coupling state in which signals resulting

from a radio wave coming from said first direction as received by said first and second dipole antennas are coupled to said combining means substantially in 180° out of phase with each other, and signals resulting from a radio wave coming from said second direction as received by said first and second dipole antennas are coupled to said combining means substantially in phase with each other.

5. The multiple frequency band antenna according to Claim 4 wherein said phase shift means includes a parallel combination of first fixed phase shift means and switching means, said parallel combination being connected between said first dipole antenna and said combining means, said phase shift means further comprising second fixed phase shift means connected between said second dipole antenna and said combining means, the amount of phase shift provided by said first fixed phase shift means being twice the amount of phase shift provided by said second fixed phase shift means.

6. A multiple frequency band antenna including an antenna group including orthogonally disposed first and second antennas, each of said first and second antennas comprising:

first and second dipole antennas disposed in parallel with each other, being spaced from each other by a distance equal to or smaller than a quarter of a wavelength in a first frequency band;

a group of extension elements including at least two first extension elements extending outward of respective ones of opposed outer ends of said first dipole antenna element along a straight line, and at least two second extension elements extending outward of respective ones of opposed outer ends of said second dipole antenna element along a straight line, the sum of the lengths of said first dipole antenna and said first extension elements and the sum of the lengths of said second dipole antenna and said

second extension elements being so determined as to enable said multiple frequency band antenna to receive radio waves in a second frequency band lower than said first frequency band;

5 a group of switch devices including first and second switch devices connected between the respective ones of said first extension elements and the respective ones of said outer ends of said first dipole antenna, and third and fourth switch devices connected between the respective ones of said second extension elements and the respective ones of said outer ends of said second dipole antenna, said third and fourth switch  
10 devices being disposed at locations corresponding to the respective locations where said first and second switch devices are disposed;

first combining means connected to said first and second dipole antennas;

15 phase shift means connected between said first and second dipole antennas and said first combining means, said phase shift means being switchable between: and

20 a first signal coupling state in which signals resulting from a radio wave coming to said multiple frequency band antenna from a first direction perpendicular to said first and second dipole antennas, as received by said first and second dipole antenna elements, are coupled to said first combining means substantially in phase with each other, and signals resulting from a radio wave coming to said multiple frequency band antenna from a second  
25 direction opposite to said first direction, as received by said first and second dipole antenna elements, are coupled to said first combining means substantially in 180° out of phase with each other, and

30 a second signal coupling state in which signals resulting from a radio wave coming from said first direction as received by said first and second dipole antennas are coupled to said first

combining means substantially in  $180^\circ$  out of phase with each other, and signals resulting from a radio wave coming from said second direction as received by said first and second dipole antennas are coupled to said first combining means substantially in phase with each other;

5       said multiple frequency band antenna further comprising:  
first and second level adjusting means for adjusting the levels of the signals from said first and second antennas, respectively;  
second combining means for combining output signals of said first  
10   and second level adjusting means; and  
control means for controlling said first, second, third and fourth switch devices of each of said first and second antennas, said phase shift means of each of said first and second antennas, and said first and second level adjusting means in such a manner that said multiple frequency band  
15   antenna can receive a radio wave in said first or second frequency band from a desired direction.

7.       The multiple frequency band antenna according to Claim 6 wherein variable phase shift means is connected between each of said first and second  
20   level adjusting means and said second combining means.

8.       The multiple frequency band antenna according to Claim 6 further comprising first and second amplifying means for amplifying the signals from said first and second dipole antennas, respectively, before coupling to said  
25   phase shift means.

9.       A signal receiving system comprising the multiple frequency band antenna according to Claim 6 wherein:  
said control means is responsive to a control signal demodulated  
30   from a modulation signal supplied thereto from modulating means through a

transmission line, by controlling said first through fourth switch devices of said first and second antennas, said variable phase shift means of said first and second antennas, and said first and second level adjusting means;

5 a signal from said second combining means is coupled through said transmission line to a signal receiving apparatus; and

said modulating means modulates a carrier with a control signal supplied from said signal receiving apparatus to provide said modulation signal.

10 10. The signal receiving system according to Claim 9 wherein said modulating means amplitude-shift-keying modulates said carrier.

11. The signal receiving system according to Claim 9 wherein said signal receiving apparatus comprises:

15 signal receiving condition detecting means for detecting a signal receiving condition in which a desired radio wave is being received; and

signal receiving apparatus control means for, when said signal receiving condition becomes unacceptable, varying said control signal to be supplied to said modulating means, and supplying said varied control signal to  
20 said modulating means when said signal receiving condition as detected by said signal receiving condition detecting means becomes acceptable.

12. The signal receiving system according to Claim 9 wherein said antenna group is supplied with a signal as received by another antenna;  
25 combining means is associated with said antenna group to combine the signal from said another antenna with a signal from said antenna group; and an output signal of said combining means is supplied to said signal receiving apparatus through said transmission line.